REMARKS

Rejection of Claims and Traversal Thereof

In the May 15, 2003 Office Action,

claims 40-55 and 61-63 were rejected under 35 U.S.C. §112, first paragraph;

claims 40-47 and 52-55 were rejected under 35 U.S.C. §102(a) as being anticipated by Miki, et al. (WO 98/01904 and U.S. Patent No. 6,309,894); and

claims 40-48 and 61-63 were rejected under 35 U.S.C. §103 as being unpatentable over Miki, et al. in view of U. S. Patent No. 5,892,254 (Park, et al.).

These rejections are traversed and reconsideration of the patentability of the pending claims is requested in light of the following remarks.

Rejection under 35 U.S.C. § 112, first paragraph

Claims 40-55 and 61-63 were rejected under 35 U.S.C. §112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Applicants have amended independent claims 40 and 63 thereby obviating this rejection. As such, applicants request that the rejection under 35 U.S.C. §112, first paragraph be withdrawn.

Rejection under 35 U.S.C. §102(a)

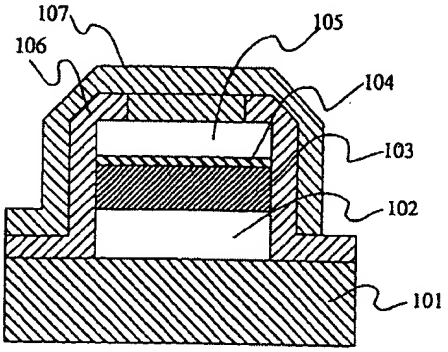
Claims 40-47 and 52-55 were rejected under 35 U.S.C. §102(a) as being anticipated by Miki, et al. Applicants respectfully submit that Miki, et al. does not anticipate applicants' claimed invention.

Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, **arranged as in the claim.** *Lindermann Maschinenfabrik GMBH v. American*

Hoist and Derrick Co., 221 U.S.P.Q. 481, 485 (Fed. Cir. 1984) The Miki, et al. reference does not meet this standard.

As shown below, in Figure 1 from Miki, et al., the structure comprises an oxygen- containing layer **104** that separates the ferroelectric material layer **103** from the top electrode layer **105**.

FIG. 1



Layer **104** is described in multiple ways in the reference, and as such, there is no definitive statement in the reference to determine the exact composition or base material of layer **104** that separates the top electrode from the ferroelectric material film. For example, as stated in the Miki, et al. specification at column 4, lines 28-34, the layer is referred to a layer formed by annealing in an oxygen atmosphere to repair oxygen loss on the surface of the high-dielectric material when the upper electrode **105** was formed. As further stated at column 7, line 60 to column 8, line 2, the layer **104** is allegedly formed on the surface of the capacitor insulating film by a method other than annealing in an oxygen atmosphere. Specifically, the Miki, et al. reference states that a deposition method "actively included oxygen in the upper electrode (in this case platinum)." Thus, the layer **104** is a layer with oxygen content but the base layer material is unclear.

By contrast, the present invention shows a microelectronic device comprising a pure metal top electrode directly deposited and contacting a ferroelectric material film as shown in Figures 1 and 2, recreated below for ease of reference. Figure 1 shows a thin ferroelectric material layer **12** between electrodes **14** and **16** of a capacitor. The ferroelectric material layer **12** may be formed of PZT, BST or SBT, deposited on the bottom electrode plate **16** by a suitable process such as CVD. The top electrode is formed of a pure metal, by sputtering in a manner consistent with the invention, to avoid depletion of the oxygen

content of the surface region of the ferroelectric oxide film **12**. Importantly, the top surface and vicinity thereof of the ferroelectric oxide film material is substantially stoichiometrically complete in oxygen concentration while the top electrode maintains it purity.

Figure 2 shows a capacitor **30** that comprises a top electrode **32**, and bottom electrode **34** on which is disposed a thin film ferroelectric material layer **36**, wherein the top surface and vicinity thereof of the ferroelectric material is substantially stoichiometrically complete in oxygen concentration. Notably, in both structures, the top electrode is not separated from the ferroelectric material layer by any additional layers. Thus, the structures of the present invention do not have a distinct and separate layer that is positioned between the top electrode and the ferroelectric material film.

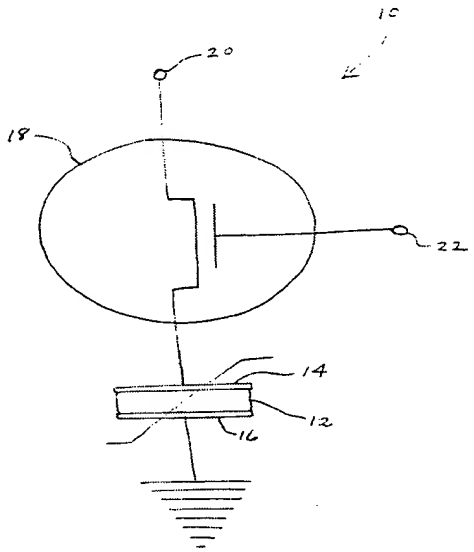


Figure 1

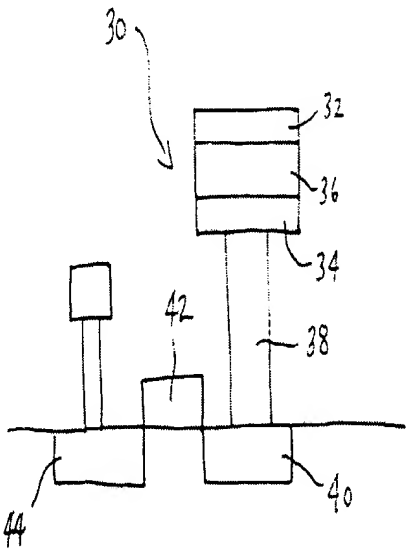


Figure 2

The specific disclosure of Miki, et al. relating to **104** layer and the exact composition of the interlayer between the top electrode and ferroelectric material layer is vague and uncertain to such an extent as to beg the question of whether the Miki, et al. reference is enabling because of the fundamental ambiguities in the reference. It is well established as a matter of law that before a reference can be prior art under section 102, a reference must be enabling and it must put the claimed invention in the hands of one skilled in the art. (*In re Sun*, 31 USPQ2d 1451 (Fed. Cir. 1993)). Further, an anticipation rejection cannot be predicated on an ambiguous reference (*In re Turlay*, 134 USPQ 355 (CCPA 1962)). A reference is good for only that which it clearly and definitely discloses. The fact that Miki, et al.

explicitly teaches that the **104** layer is an insulating layer, while concurrently stating that oxygen is incorporated directly into the crystal structure of the platinum electrode introduces confusion as to what exactly is being disclosed in Miki, et al. It is well established in the law that if a reference is ambiguous and can be interpreted so that it may or may not constitute an anticipation of an applicant's claim, an anticipation rejection under 35 U.S.C. §102 based upon the ambiguous reference is improper (*In re Hughes*, 145 USPQ 467 (CCPA 1965)). This is the current situation, and as such, Miki, et al. does not support an anticipation rejection.

Accordingly, claims 40-47 and 52-55 patentably distinguish over Miki, et al. Withdrawal of the §102 rejection therefore is required.

Rejection under 35 U.S.C. §103(a)

In the May 15, 2003 Office Action, claims 40-48 and 61-63 were rejected under 35 U.S.C. §103(a) based on a combination of Miki, et al. and Park, et al. Applicants submit that the introduction of Park, et al. does not overcome the shortcomings of Miki ,et al., and thus, the combination of the cited references does not in any way render applicants' claimed invention *prima facie* obvious.

As stated above, Miki, et al. describes a structure that includes a layer of oxygen containing material **104** positioned between the top electrode **105** and the ferroelectric material layer **103**. This **104** layer is formed by annealing the structure in oxygen after the top electrode is deposited, or in the alternative, the layer is formed by incorporation of oxygen into the crystal structure of platinum during deposition of the top electrode. However, as further stated in column 8, lines 12-16, the platinum film that is sputtered in pure oxygen comprises microparticles, and thus compromises the purity of the metal electrode and the crystal structure. The problem is recognized by Miki, et al. at column 8, lines 11-14 which expressly states that the crystal properties of the platinum are extremely poor.

Park, et al. describes a capacitor that prevents diffusion of oxygen from a dielectric layer by providing a barrier layer comprising refractory metal and grain boundary filling material. The barrier layer can reduce and preferably prevent diffusion of oxygen therethrough, and thereby reduce the leakage current and oxidation of the integrated circuit capacitor. The barrier layer, which is the gist of the Park, et al. disclosure, is deposited beneath the lower electrode. Park, et al. may discuss electrode materials

corresponding to applicants' electrode materials but there is no teaching or suggestion that the surface of the dielectric layer is substantially stoichiometrically complete in oxygen concentration.

Applicants submit that the Office has not provided objective or specific teachings or suggestions in the cited prior art to motivate one skilled in the art to combine said references. Clearly, neither reference teaches or suggests all the elements of applicants' claimed invention including a top electrode comprising pure metal that contacts directly with a ferroelectric material film layer that comprises a top surface and vicinity thereof that is substantially stoichiometrically complete in oxygen concentration. There is no definitive statement in Miki, et al. to clearly determine the exact composition of the 104 layer. Moreover, applicants question why one skilled in the art would go in the direction of applicants after reading the Miki, et al. disclosure? Miki, et al. clearly states that a platinum film sputtered in pure oxygen comprises microparticles and loses practically all of its orientations in the (111) direction and the crystal properties are extremely poor (see column 8, lines 11-14).

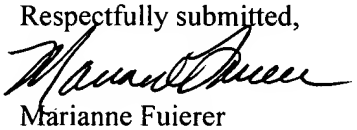
Applicants further submit that the Office has failed to give weight to the advantages and benefits of the present invention in considering the "invention as a whole" and that the Office has cited references that do not disclose or teach such advantages or benefits. Applicants note that for some metals used in the deposition of electrodes the use of postdeposition annealing may be acceptable because the top electrodes will allow oxygen to diffuse therethrough to replenish the oxygen content of the underlying dielectric layer. However, this method is not acceptable when using preferred materials such as Ir and IrO_2 because they are not good oxygen diffusion barriers. Thus, applicants recognized this shortcoming and the presently claimed invention allows for the deposition of the preferred top electrode material by depositing in an oxygen atmosphere, which replenishes the oxygen content to the upper surface of the ferroelectric oxide layer. Moreover, applicants found that electrodes formed by sputtering at sufficient pressure, temperature and rate of deposition did not incorporate oxygen into the crystal structure of the electrode material, and as such, the electrodes exhibit lower compressive stress characteristics than those sputtered in the presence of oxygen where oxygen is incorporated in the electrode film. These lower compressive stress electrodes are desirable to facilitate the subsequent fabrication of additional layers and or to enhance the end-use device characteristics of the structure. Obviously, the cited references do not recognize these benefits of the present invention.

In light of the above discussion and the fact that the Office has not met its burden of establishing a *prima facie* case of obviousness, applicants request that the rejection of claims 40-48 and 61-63, on §103 grounds, be withdrawn.

CONCLUSION

Applicants have satisfied the requirements for patentability. All pending claims are free of the art and fully comply with the requirements of 35 U.S.C. §112. It therefore is requested that Examiner Hu reconsider the patentability of claims 40-47, 49, 51-54, 61 and 63, in light of the distinguishing remarks herein, and withdraw all rejections, thereby placing the application in condition for allowance. Notice of the same is earnestly solicited. In the event that any issues remain, Examiner Hu is requested to contact the undersigned attorney at (919) 419-9350 to resolve same.

Respectfully submitted,



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